SPERRY

Simulation and Training Systems...

. . . *because someone asked Sperry*

Listening and responding to our customers is our way of doing business. It's what has made Sperry a major developer of simulation and training systems for both military and commercial applications.

The increasing complexity of modern machines and technology systems has created a growing demand for simulators. Over a wide range of high technology disciplines, simulation—the duplication of complex equipment systems in controlled environments—provides the basis for effective research and training.

Using simulators in place of prime, "real world" systems provides important benefits, the most obvious of which are increased safety and economy, and the minimization of real equipment wear. Simulation also affords a totally controlled learning environment, providing training effectiveness and evaluation results often impossible to achieve with training conducted on prime systems, or in traditional classroom tutorial training.

It is the training system designer's responsibility to maximize the benefits to be derived by those who will use the system. In meeting this responsibility, the designer must keep the following objectives in view:

- To ensure that the simulation subsystems will provide faithful reproduction of prime system performance. This will help ensure that the student, who must trade prime system operating time for trainer time, will receive at least an equivalent learning environment.
- To provide objective and efficient instructional subsystems in the trainer. This ensures that the student can receive consistent training inputs, and the instructor can receive meaningful measures of training results.

Recognition of this responsibility is the basis for all Sperry simulation design, construction, and modification programs.

Sperry has been a leader in the training of technical personnel since the beginning of this century, when the first Sperry navigation equipment was installed aboard ships and aircraft.

In 1960, Sperry's extensive experience in mathematical modeling, real-time data processing and systems integration was applied to the development of sophisticated navigation trainers for United States Navy fleet ballistic missile submarine crews.

Since then, Sperry has actively engaged in developing a broad spectrum of state-of-the-art simulators and trainers for applications to aircraft, ships and land-based activities. Typical programs are described on the pages which follow. They are responses to particular needs of our customers—illustrating that at Sperry, ***we understand how important it is to listen.***

air

Sperry's activity in flight training simulation is centered at the Sperry facility near Washington, D.C.

Engineering, manufacturing, support and administrative functions are performed here. Sperry flight simulation technology encompasses specification development, electrical and mechanical design, configuration management, math modeling, systems integration and integrated logistics support.

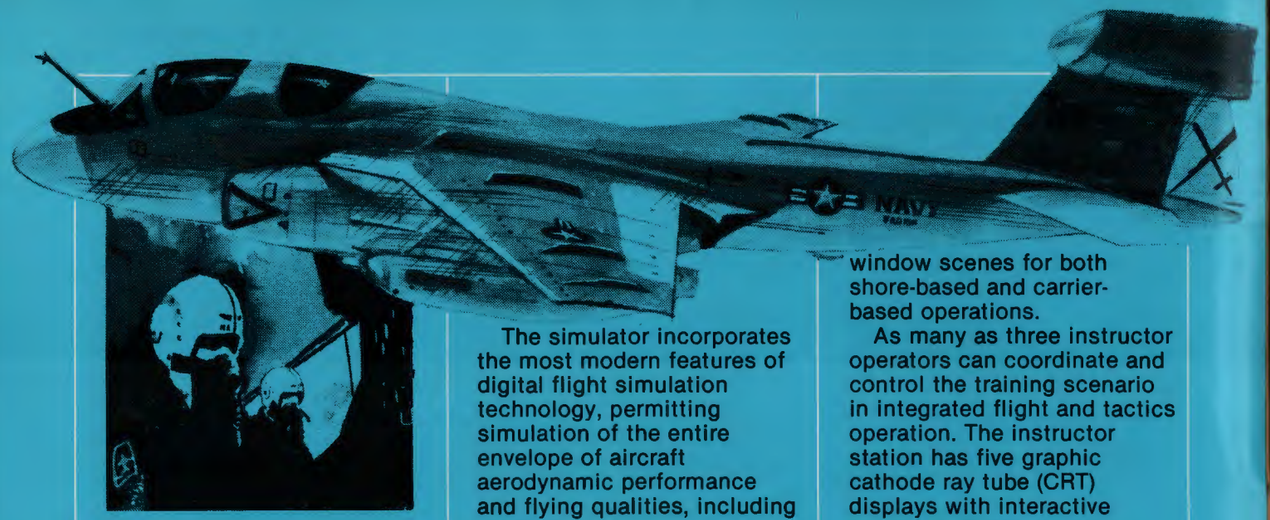
A specialized Sperry staff supports the equipment we manufacture. Our field service engineers maintain simulator installations. Our training personnel instruct our customers in equipment operation and maintenance skills.

Our products range from highly complex weapon system trainers for interactive full-crew training, to elementary part-task trainers for individual operators. These systems employ modern digital technology to provide simulation of flight vehicle dynamics, engine and auxiliary systems, weapons delivery, electronic warfare, and communication/navigation equipments.

The modern military aircraft weapon system trainer depends upon a digital computer complex to provide realistic simulation of combat conditions. The computer interfaces with the simulated cockpit, motion system, avionics equipments, weapons systems, and instructor station to provide optimum realism.

All training exercises are controlled from a custom-designed instructor station. From his console, the instructor can program the exact flight scenario required, and monitor student performance in detail.

The instructor station design features automated performance monitoring, dynamic critique replay, conditional malfunctions, and adaptive training to assist the instructor in developing trainee skills.



EA-6B Weapons System Trainer

The most sophisticated electronic warfare aircraft now operating in the U.S. Navy is the EA-6B Prowler.

The EA-6B is designed to employ high power jammers and other electronic countermeasures to disrupt enemy radar and communications, thus screening its own strike force aircraft from surface-to-air missiles. This aircraft also protects surface ships from radar detection by enemy aircraft, and from cruise missiles.

Sperry designed and built the EA-6B Weapons System Trainer under a prime contract from the U.S. Naval Air Systems Command. This trainer is the U.S. Navy's largest and most technically advanced flight simulation training device, providing accurate reproduction of aircraft operational and performance characteristics, the environment within which the aircraft operates, and the interrelationship of performance and environment. A high level of fidelity is achieved through extensive real-world simulation of the radars, visual scenes, and radio communications.

The simulator incorporates the most modern features of digital flight simulation technology, permitting simulation of the entire envelope of aircraft aerodynamic performance and flying qualities, including stalls and spins.

The Sperry EA-6B trainer simulates engine performance, auxiliary systems, ground handling, carrier catapult launch and recovery, wing fold, ejection seats, G-suits, environmental control systems, flight instruments, and communication/navigation systems.

It also includes digital radar landmass simulation of search radar, with 1.6 million square miles of landmass data base storage. Terrain and cultural features stored for display include shadows, refraction and earth curvature, far shore brightening, range attenuation, moving targets and emitter occulting.

Electronic countermeasure simulation covers tactical and defensive jamming systems, communications jammer, and chaff dispenser.

A four-position trainee station is mounted on a six degree-of-freedom motion system. A computer-generated image visual system displays out-the-window scenes for both shore-based and carrier-based operations.

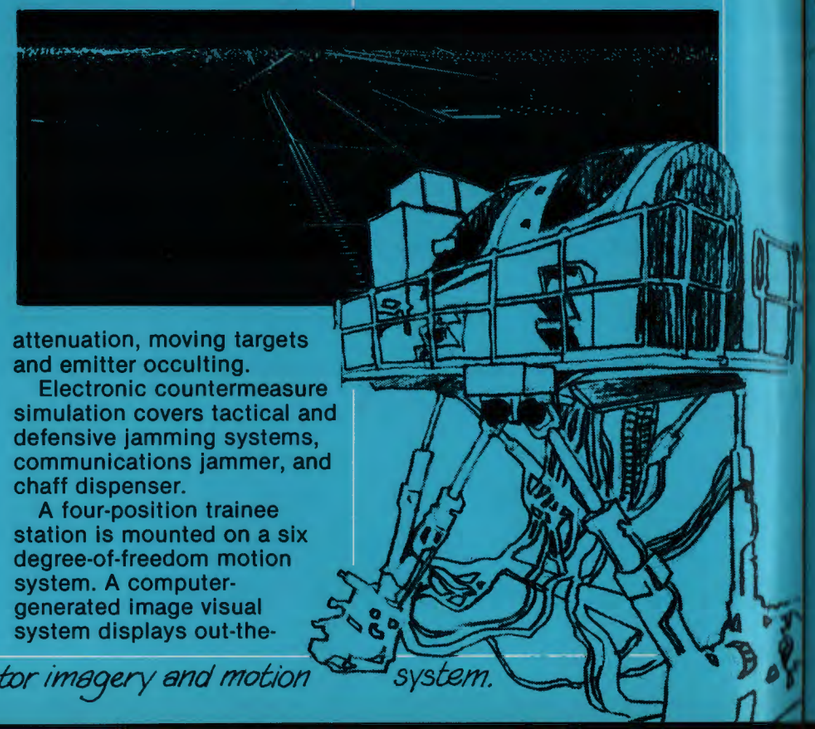
As many as three instructor operators can coordinate and control the training scenario in integrated flight and tactics operation. The instructor station has five graphic cathode ray tube (CRT) displays with interactive terminals. There are also repeat displays of the visual scene, radar, digital radar landmass simulator, and tactical jammer at the instructor console.

The instructor station is designed for maximum flexibility in trainer operation by including a number of preprogrammed demonstration maneuvers.

Other special features include 20-minute dynamic replay and computer evaluation of trainee performance in both flight and tactics mode.

While the Navy will realize substantial cost savings by substituting EA-6B trainer flight hours for actual aircraft flight hours, the value of the trainer is derived from the safe, in-depth training it provides, which cannot be duplicated by using actual aircraft alone.

In conjunction with actual aircraft flying time, the EA-6B trainer enables the Navy to operate a total training program with a goal of developing the highest achievable level of crew proficiency—a proficiency vital to the EA-6B's mission of protecting other aircraft and surface ships.



EA-6B simulator imagery and motion system.

EA6B instructor station.

A-6E Simulator Trainers

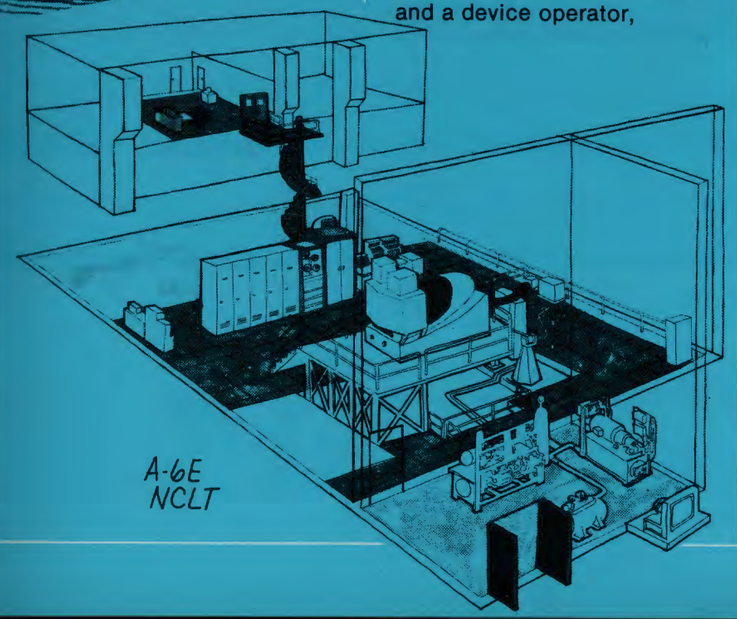
The U.S. Navy's primary carrier-based low-level attack bomber is the A-6E Intruder. Designed specifically for all-weather and night operations, the Intruder is a two-place subsonic aircraft capable of carrying heavy and diverse ordnance loads.

Night Carrier Landing Trainer

This Sperry trainer provides vital training in night carrier launch and recovery functions.

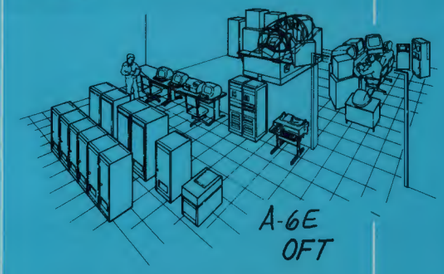
The two-position trainee station consists of a visual simulation system, a three degree-of-freedom motion system, a central instructor station, and a digital computer complex. The simulator is designed to provide crew training in both transition and proficiency maintenance.

The instructor station features a graphic CRT display system, and accommodates an instructor and a device operator, although the trainer can be operated by either alone. All aspects of device function and training problem control are operated from this instructor station.



A-6E NCLT

Operational Flight Trainer



A-6E OFT

This trainer simulates the pilot and bombardier/navigator stations of the A-6E aircraft and provides training in cockpit preflight and starting procedures, aircraft maneuvering throughout the full flight regime, normal and emergency procedures, navigational and instrument flight procedures, and both land-based and aircraft carrier takeoffs and landings. In addition, it provides semi-automatic training exercises, check-ride administration, and performance recording and scoring.

The trainer consists of a simulated A-6E cockpit, a three-window visual simulation system, an instructor/operator console, a general-purpose digital computation system, a G-seat/G-suit system, a limited cockpit motion system, and electronic interface equipment.

The visual simulation system uses computer-generated imagery to simulate dusk/night scenes of various airfields, an aircraft carrier, and cross-country flight. The G-seat/G-suit system provides realistic acceleration cues representative of simulated flight conditions. The instructor/operator console utilizes three graphic CRT display units for control and monitoring of the training exercises. This console also

includes a visual system monitor for displaying, on a selected basis, any of the visual displays presented to the pilot and bombardier/navigator. The motion system provides simulation of buffet and cockpit vibration.

The pilot's position in the cockpit is completely simulated and includes communication with the bombardier/navigator to achieve training in the close coordination required for all phases of A-6E missions.

Training realism is enhanced by the simulation of a large number of possible aircraft malfunctions. These may be inserted by the instructor or may be programmed to occur automatically at pre-selected times during a training mission.

A unique feature of the trainer is the use of an electronic voice synthesizer to provide GC/GCA commands as a function of computed aircraft position and performance.

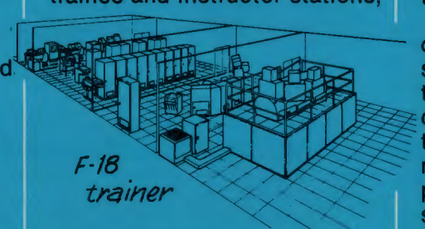
F/A-18 Operational Flight Trainer

The F/A-18 Hornet is the U.S. Navy's newest fighter/attack aircraft. This multi-role fighter provides dogfight capability superior to any tactical Navy fighter, and light attack capability greater than any aircraft in the Naval attack community.

Sperry's F/A-18 Operational Flight Trainer is a key element in an extensive pilot training program for this capable aircraft. Designed to effect the most efficient, in-depth learning transfer for Navy pilots, the trainer simulates the physical and performance characteristics of the actual aircraft, the environment within which it operates, and the effects of that environment on aircraft performance.

Particularly valuable to Navy pilots are the simulated carrier operations provided by a complete simulation of the USS Nimitz environment including approach, wave off, arrested landing, bolter, touch and go, barricade arrestment, deck taxi, catapult tensioning, and catapult launch. Similar effects are provided for landing field simulation.

The trainer consists of trainee and instructor stations,



F-18 trainer

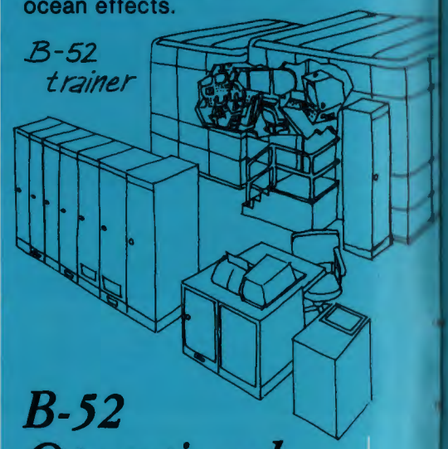
a computer system, and a three-window, three-channel visual system.

The trainee station includes a simulated F-18 cockpit, an elevated cockpit access platform, the visual display system, and a support structure for transmitting seat and buffet loads to the facility floor. A G-seat/G-suit system combined with the seat buffet constitutes the acceleration cueing motion system. The operational cockpit display system consists of a heads-up display, master monitor display, horizontal situation display, and up front control.

The instructor station allows operation either jointly or individually by an instructor and a device operator, and can accomodate an observer. The instructor display system is a two-CRT display controlled by a keyboard and discrete function switches. Computer control gives the instructor complete freedom in structuring and monitoring the training exercise and ensures objective, consistent instructional inputs to the trainees and evaluation of their performance. The instructor training management system encompasses: malfunction programming, procedure monitoring, record/playback, automatic flight demonstration, trainee performance measurement, display hardcopy printouts, terminal (landing) condition printout and flight parameter reading.

Malfunctions can be inserted or programmed from the CRT keyboard and the trainer design allows for modification and expansion of this simulation. The trainer can therefore be kept current with aircraft developments and updated training requirements.

The three-window, three-channel visual system is a CGI system which contains all of the features required to conduct the F/A-18 OFT training missions. The night/dusk data base provides a primary Naval Air Station and surrounding area approach features, USS Nimitz aircraft carrier with destroyer escort and wake, four commercial and military airports and their surrounding area, a generic airfield with features typical of Navy installations, weapons delivery target with ring target, and a generic countryside to be used to fill in between the fully developed scenes. Media simulation includes atmospheric, magnetic, and ocean effects.

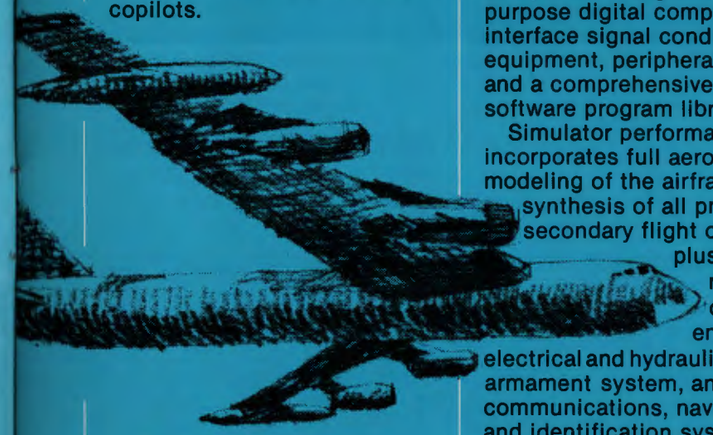


B-52 trainer

B-52 Operational Trainer

The primary bomber of the U.S. Air Force is the B-52. Known as the Stratofortress, this aircraft is designed to maintain a speed of 650 m.p.h. at 50,000 feet while carrying a crew of six on bombing missions.

Sperry was a prime contractor to the Air Force for refurbishment and digital update of the G and H models of the B-52 flight simulators used to train B-52 pilots and copilots.



By converting existing trainers to the latest state-of-the-art digital systems, Sperry provided the Air Force with a cost-effective alternative to the design and construction of completely new trainers. Most significantly, the Sperry modification programs produced major schedule savings, while providing completely new digital systems with significantly increased capacities and additional life expectancies of twenty years.

The simulators are used to teach the procedures and techniques for tactical missions, emphasizing references to instrument indications. The trainers simulate all controls and instruments required in the execution of ground operations, take-off, landing normal flight, radio communication/navigation problems, instrument approach procedures, and emergency conditions.

Each trainer consists of a flight compartment, instructor's compartment, and computation system.

The flight compartment is an accurate replica of the pilot and copilot positions. The instructor compartment is located immediately behind the cockpit and includes a control panel, keyboard, and CRT display system. The computation system is comprised of a general-purpose digital computer, interface signal conditioning equipment, peripheral units, and a comprehensive software program library.

Simulator performance incorporates full aerodynamic modeling of the airframe, synthesis of all primary and secondary flight controls, plus math modeling of the engines, electrical and hydraulic systems, armament system, and the communications, navigation, and identification systems. An environmental sound synthesization unit duplicates engine, aerodynamic, and tire noises. These are integrated to enhance the illusion of flight.

The instructor's display system presents several categories of information and serves as the primary medium for instructional data input and output.

In support of the B-52 program, Sperry has delivered an antenna scan pattern generator for the AN/ALQ-T4 Electronic Warfare Trainer. This digital device uses a low-cost distributed microprocessor technology and floppy disc storage media. It supplies a time-based attenuation pattern to simulate antenna scans of enemy threat radars.

A-4 Operational Flight Trainer

The A-4 Skyhawk is an attack aircraft of the U.S. Marine Corps. It provides close air support and weapons delivery.

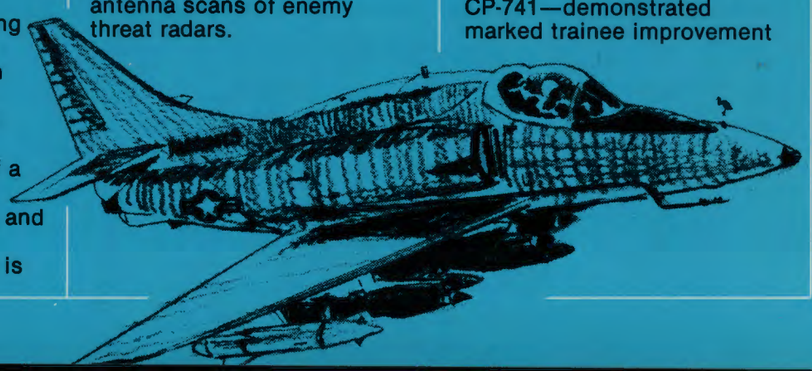
Sperry has designed and built seven A-4 simulators. Two simulators are being used by the U.S. Navy and Marine Corps, and five are used by other governments.

The scope of training offered by these trainers covers the entire range of aviator training: initial cockpit indoctrination and familiarization, basic and intermediate instrument flight proficiency, threat detection and evaluation, weapon delivery, and complete normal and emergency procedures.

The training system includes automated instructional features such as computer-assisted problem set-up, procedural sequence monitoring, preprogammed malfunction insertion, and a computer printout of trainee proficiency. Most of the Sperry-built A-4 simulators have record/playback and spin simulation capability.

Sperry's trainer simulates the Angle Rate Bombing System (ARBS). In conjunction with a visual system, this allows the pilot/trainer to attain proficiency with the ARBS developed by the Naval Weapons Center.

Previous experience with the ARBS predecessor—the CP-741—demonstrated marked trainee improvement



Sperry A-4 trainer cockpit.

in weapons delivery upon incorporation of that system in the simulator.

Addition of a visual system will provide new capabilities including terrain navigation, low-level navigation, hostile gaming area operation, air-to-ground and air-to-air weapon delivery, plus aerial refueling procedures, formation flying, weapon impact and scoring, independent moving vehicles, target flares, and carrier operations.

Helicopter Simulation

Sperry experience in helicopter flight simulation includes the design, development, and delivery of training equipment for the CH-3E, HH-3F, HH-53C, HH-52A, UH-1E, TH-1L and CH-47 helicopters.

This activity has resulted in our development of completely new math modeling techniques for helicopter aerodynamics and engine operation. The aerodynamic and engine mathematical models provide a complete and accurate reproduction of the performance and flight handling characteristics of the helicopter throughout its entire operational flight envelope.

The models include buffet and stall effects, autorotation, power settling, ground effect, ground resonance, and variable turbulence in addition to normal cruise, climb, descent, and turn responses.

Sperry's Specific Response Approach math model provides a precise reproduction of main rotor, tail rotor, and fuselage aerodynamic forces, including all static and dynamic interactions.

CH-53 Operational Flight Trainer

Sperry is presently under contract to design and construct operational flight trainers (OFT) for the CH-53D and CH-53E helicopters of the U.S. Marine Corps.

The Marine Corps will use these helicopters as workhorses for heavy lift applications such as armor and artillery.

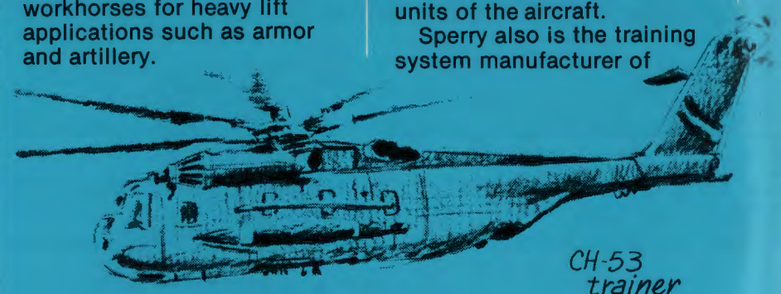
The OFTs consist of a trainee station (simulated aircraft cockpit with all applicable instrumentation and controls), an instructor station, a six degree-of-freedom motion system, and a digital computation system with a full complement of peripheral equipment.

The OFTs contain a full daylight, six-window six-channel CGI visual system with a 196-degree horizontal and 60-degree vertical field of view. This visual system provides for both land and sea operational environments.

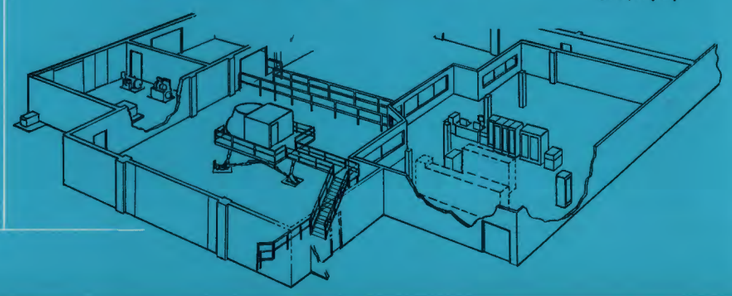
The OFTs offer training in cockpit preflight and starting procedures, aircraft maneuvers, normal and emergency procedures, navigational and instrument flight procedures, load operations, functional check flight procedures, landing and takeoff procedures, shutdown and post flight procedures, and standard shipboard procedures.

The trainee station will be capable of operating in a semi-automatic training mode or a check-ride mode in order that demonstration, prerecorded training exercises, check-ride administration, performance, and scoring may be conducted. The trainers will faithfully simulate specific production units of the aircraft.

Sperry also is the training system manufacturer of



CH-53 trainer

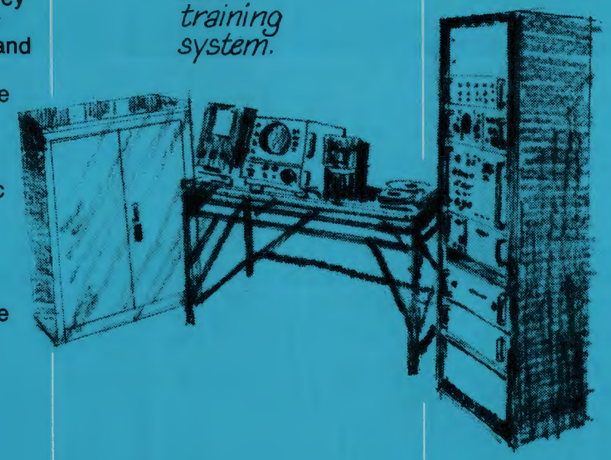


System 14E10 for AN/AQS-13 helicopter-borne anti-submarine warfare sonars. These devices are currently in service with the U.S., Canadian, and Italian navies.

The AN/AQS-13 training includes a family of four separate units. Together, they provide complete capability for collecting, processing, and presenting information required in a comprehensive sonar operator training program.

This system involves dipping sonar and Magnetic Anomaly Detection capability and employs sonobouys and other new technologies.

This effort will ensure the availability of trained personnel as new technologies become available to the fleet.



Sperry sonar training system.

ASW Sonar Training Capabilities

Dipping Sonar

Magnetic Anomaly Detection

Mine Detecting Sonar

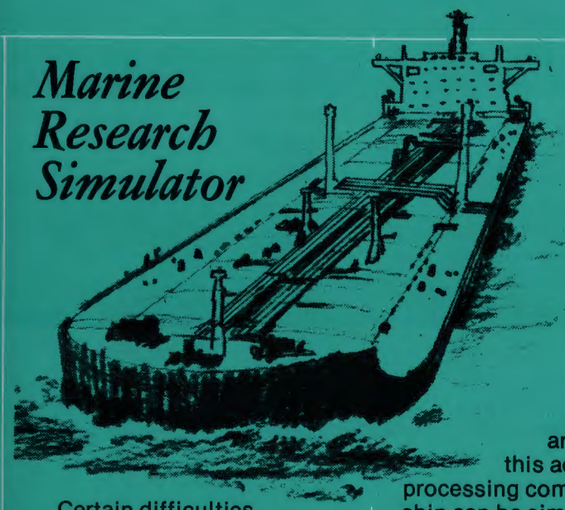
Sperry ship simulators convincingly reproduce the gamut of hydrodynamic and environmental features, ranging from suction effects to wind and current conditions, from harbor lights to fog at night. These and other features are necessary to familiarize the student with all conditions he will face at sea and—aboard submarines—below it. This realism is vital not only for trainees, but also for experienced ship handlers being trained on new types of vessels.

sea

Sperry's experience in combat system integration for guided missile frigates has led to the development of a unique combat system team operation trainer. This system provides realistic initial crew qualification training and replacement crew training, using principles applicable to a wide range of ship classes.

Sperry electronic warfare training systems provide the means for trainees to obtain a high level of skill in a realistic environment.

Marine Research Simulator



Certain difficulties associated with handling modern supertankers are a source of deep public and governmental concern for the protection of human life and the environment.

The U.S. Maritime Administration, identifying shiphandling research as a prime area of investigation relevant to these concerns, contracted with Sperry to design and install a Computer Aided Operations Research Facility (CAORF) at the National Maritime Research Center at Kings Point, N.Y. This simulator became operational in 1975.

CAORF provides the most advanced ship operations simulation techniques available. It investigates methods of increasing productivity and reducing casualties without incurring the expense or risks of at-sea shipboard testing, and with a control and repeatability not possible at sea.

The CAORF wheelhouse incorporates a full complement of modern navigation and piloting equipment. A 125-foot, 240-degree wraparound projection screen offers sweeping, full-color, detailed views of harbors, complete with other ships. Five television projectors fill the screen with a lifelike, computer-generated environment.

Behind the wheelhouse lies the extensive computer facility which creates the operational environment. The physical parameters and landmarks of each harbor chosen for simulation, and the complete dynamic characteristics of the ship being tested, are stored within this advanced data processing complex. Any ship can be simulated in the CAORF system, even down to the apparent height above the waterline represented by the wheelhouse view.

The computers control all of the instruments, from gyrocompass to engine RPM indicator. These instruments respond to operator inputs precisely as they would in actual, underway conditions.

Radar inside the wheelhouse displays the same land masses, features and traffic being displayed on the projection screen. Sounding equipment indicates the actual depth at that point in the harbor. Simulated sounds and working radio communication channels add to the realism.

From a central console in the control room, researchers set up navigation, piloting and ship control problems under varying conditions of night, day, fog, rain, wind, tide and current. Experienced deck officers and seamen from major shippers take CAORF through these exercises.

As the deck officer responds, industrial psychologists monitor and evaluate the exercise. If necessary, a problem is repeated as a whole or in part for further evaluation.

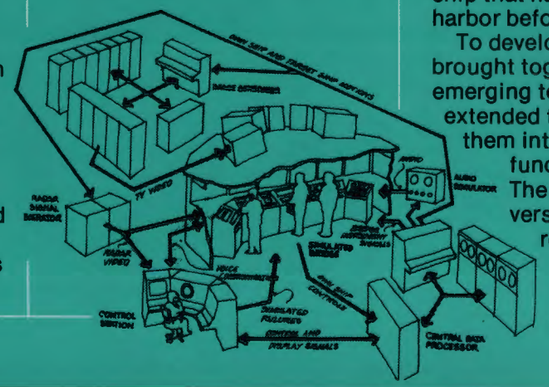
CAORF helps probe for the safe operating limits of various ship types and classes under the widest possible conditions. Collision avoidance displays, transponders and other new equipments are evaluated safely and economically under precise and repeatable conditions.

CAORF was of value in bringing supertankers into Port Valdez, Alaska, at the Southern end of the Alaska pipeline. Studies of the

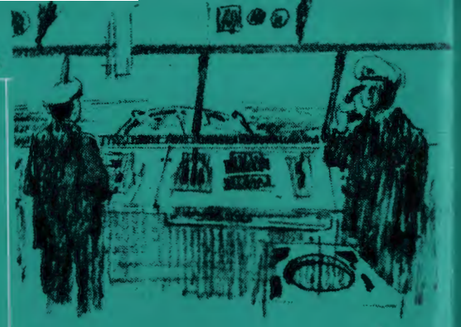
effects of weather and tide conditions at Port Valdez were conducted through CAORF simulations, and resulted in the specification of minimum safe operating conditions.

After these safe operating limits were established, Port Valdez harbor pilots were brought to CAORF to gain experience in handling tankers much larger than any ship that had put into the harbor before.

To develop CAORF, Sperry brought together a number of emerging technologies, extended them, and integrated them into a smoothly functioning system. The result is a highly versatile research tool, readily adaptable to present and future maritime studies.



Realism on the simulated bridge



Commercial Shiphandling Trainers

FlightSafety International in New York, for three decades, has been a leader in aircraft pilot training. When it expanded activities to commercial ship pilots and officers by forming a new organization called MarineSafety International, Sperry was commissioned to develop a commercial shiphandling trainer.

This facility simulates the characteristics of many different ship types and classes under varying current and weather conditions. Black and white imaging equipment projects a 140-degree dynamic scene which includes moving marine traffic.

The image is generated by a computer-controlled, wide-angle television probe, moving over a detailed scale model of the harbor area. These 15-by 30-foot models are complete with channel markers, blinking buoys, ranging lights, and shore features. All are accurately reproduced in 1/2,000 scale.

Sperry furnished models of harbors at Milford Haven, Wales and Ras Tanura, Saudi Arabia, to train tanker captains for a major oil company. Additional models, including those of the Chesapeake Bay, the Savannah River, and Port Valdez, Alaska, were built to suit the needs of other simulator customers.

This simulator offers the feel of a real ship at a commercially viable cost. It has proven valuable in training personnel for new classes of ships, such as LNG carriers, and in upgrading skill levels to handle larger ships, including the difficult but vital maneuvers needed to dock large, cumbersome vessels with and without tugboats.

Trident Submarine Control Trainers

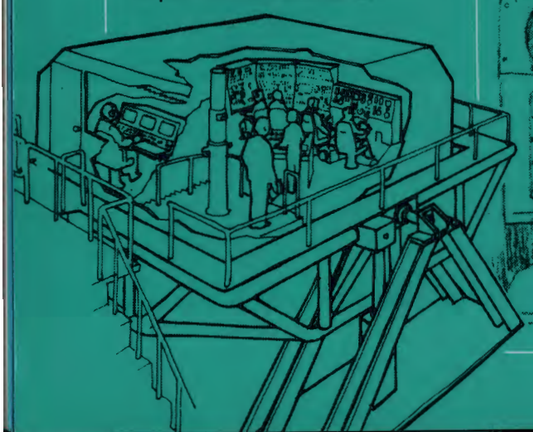
The Trident submarine is regarded as one of the world's most sophisticated weapons systems. Each Trident carries 24 missiles, and each missile has 12 warheads. A Trident missile is capable of traveling 4,000 nautical miles, approximately 1,500 nautical miles farther than its predecessor.

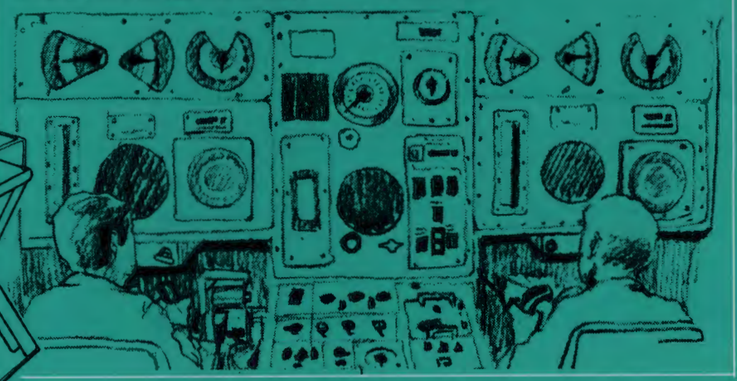
Because of massive responsibilities involved in handling such a complex ship, Sperry was called upon to provide the trainer on which Trident crews are learning to dive, steer and control the submarine.

Installed at the Trident base in Bangor, Washington, the trainer rests on a 14-foot by 18-foot, two degree-of-freedom motion platform, which simulates the pitch and roll of a Trident. All controls and instruments in the trainer are designed to closely duplicate the appearance, layout and function of the six-man control station.

To provide the advanced training the Navy required, Sperry built the trainer while the first Trident—the Ohio—was still under construction. The first crews were trained prior to actual launching.

The completed simulator offers the trainee the effects of diving, surfacing, depth keeping, ballast compensation, maneuvering, water turbulence, missile firings and other dynamic characteristics of the real submarine, all under the control of an instructor who can modify the training scenario to insert emergency situations.





Submarine Navigation Systems: Operation and Maintenance Trainers

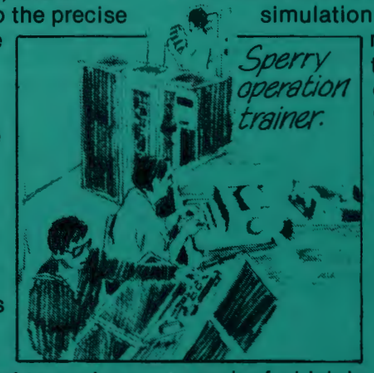
Strategic submarine navigation system accuracy is vitally important to the impact accuracy of a subsurface-launched missile, and is directly related to the precise knowledge of the position, attitude, and velocity of the submarine at the time of launch.

In addition to being highly accurate, such a system must be reliable—ready to fulfill its purpose at all times—to be an effective deterrent to nuclear aggression.

As part of its role in the Polaris/Poseidon/Trident program, Sperry designed, integrated and installed facilities necessary for operational and maintenance training of the navigation crews of these submarines.

Sperry designed and built five operation trainers containing operational equipment, simulators/stimulators, digital simulator computers, and instructor consoles. Crew members receive hands-on training at the equipment, equipment subsystem, and overall system levels.

Sperry also constructed 39 maintenance trainers comprised of operational equipment, simulators/stimulators and malfunction simulation, used for maintenance training on the equipment and equipment subsystem level.



In addition to these maintenance trainers, Sperry installed three maintenance laboratories, each of which is equipped with a digital simulation computer, CRT display and printer. Using synthetic operating data, crew members receive system operational training at the supervisory level.

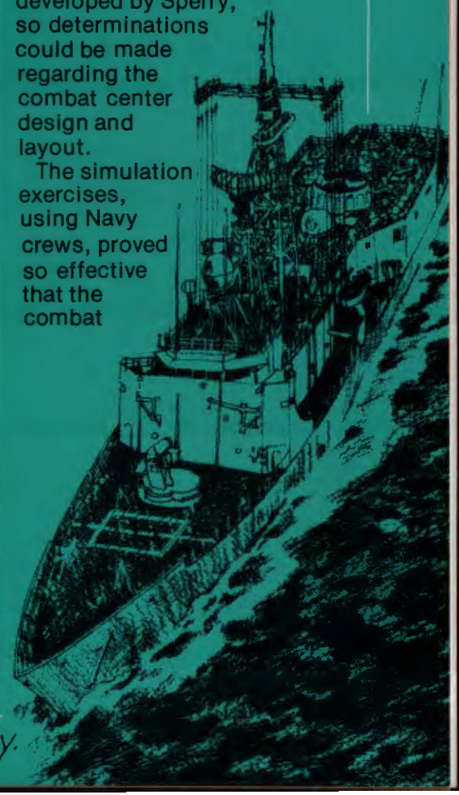
Sperry maintenance trainer.

Ship Combat System Trainers

The success of the FFG-7 class guided missile frigate was largely due to an effective, commendation-winning combat weapon system integration program, implemented by Sperry for the U.S. Navy. The key to this program's success was the development of a land-based test site, which included early crew training through weapon system simulation, and led to the development of a unique Sperry combat system trainer.

The land-based test site for the FFG-7 was originally developed to uncover any problems with the design and integration of the ship's combat system center, which might otherwise become apparent only after shipboard installation of the equipment. In order to provide effective tests of the design of the center, simulation of various combat situations were developed by Sperry, so determinations could be made regarding the combat center design and layout.

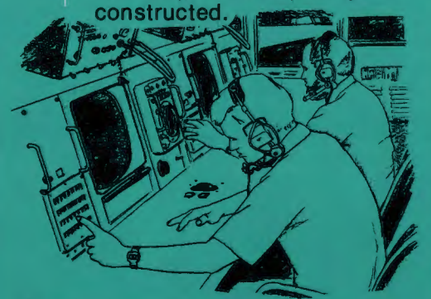
The simulation exercises, using Navy crews, proved so effective that the combat



USS Oliver Hazard Perry.

system of the lead ship—the USS Oliver Hazard Perry—was validated months before being installed.

The simulation exercises also proved successful in providing a major innovation in the operational training of Navy crews designated to the test site. By training on this working combat system at the center, crew members learned to operate and maintain the entire system even before the lead ship was completely constructed.



Combat system team training.

This led to Sperry's development for the Navy of an FFG-7 Class Combat System Team Operation Trainer (CSTOT), which has been installed at a Navy training center in Virginia. The new trainer provides integrated training in the operation, utilization, and tactical application of the FFG-7 combat systems and equipment for initial crew qualification and replacement crew training.

The trainer includes a radar target simulator, gun simulator, missile launcher, and missile simulators; subsurface targets and acoustic detection models; MK-309 control panel, torpedo tube, and torpedo simulation; AN/SLQ-32 electronic warfare suite simulation; LAMPS-MK-I simulation, and MK-15 Close In Weapons Systems (CIWS) simulation.

This unique Sperry simulation concept is applicable to training crews on combat systems for patrol boats, frigates, destroyers, and other ship classes.

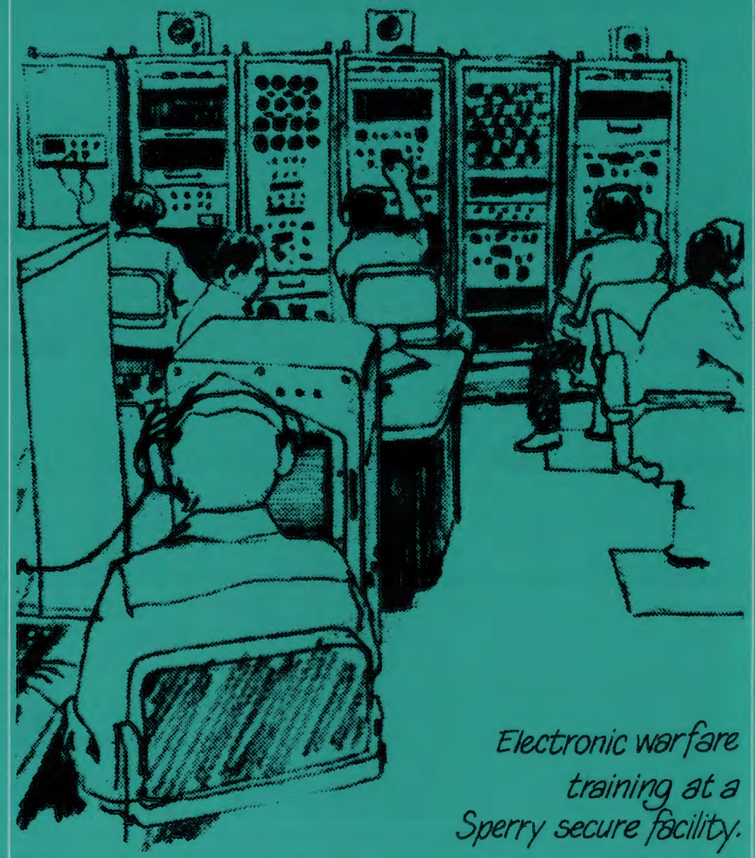
Electronic Warfare Simulation

In military operations, shipboard tactical signal intelligence—often referred to as electronic warfare—is gaining an increasingly important role. This discipline demands a great deal of skill on the part of the operator.

Electronic warfare training systems are required to provide training from basic operator through advanced team training. Advanced team training requires a dense and realistic signal environment, in which various types of signals are provided over the full frequency spectrum. Sperry is presently under contract for the design and development of such a system.

Computer-controlled generators provide signals with the proper characteristics to coordinate with the events of the training exercise. Libraries are provided to assist in the construction of training exercises that can then be recorded for automatic replay during training. Sample exercises which are used for basic operator training can be combined, to form complex training exercises.

The present system provides signals to the students through the use of equipment stimulation, and many of the techniques and principles can be applied to systems where front panel simulation is desired. Concepts used will apply to many electronic warfare trainer requirements, and the technology can be transferred to other agencies. The concepts used apply equally well for basic through advanced training.



Electronic warfare training at a Sperry secure facility.

Land combat training is mandatory for armed forces readiness. Simulation of land combat conditions must cover teamwork coordination as well as individual skills such as marksmanship.

Simulation for land-based military personnel must present all the dynamics involved in attack, patrol and defense.

These situations must be presented in every climatic and geographic condition which will be faced in combat.

land

Remoted Target System (RETS)

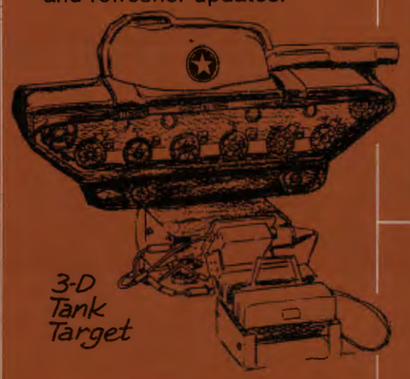
Remote target control console.

RETS, the Remoted Target System, was developed and produced by Sperry for the U.S. Army.

This system is the only trainer which simulates the dynamic combat situations necessary for infantry and armor automatic-weapon firepower training. It is geared to achieve the goals of combined arms training and annual arms qualification, including defense, movement to contact, and attack.

IRETS (Infantry RETS) uses three-dimensional targets with the physical characteristics of aggressors. The computer-controlled targets pop up and down, remain stationary, move back and forth and dart from side to side. They operate in an atmosphere of convincing sound and sight effects—ranging from hostile gunfire to simulated muzzle flashes at night.

For combined arms training, a one-fifth scale 3-D tank target is available to mount directly on a small target-lifting mechanism identical to that used with IRETS. These targets provide a realistic one-fifth scale armor range that offers extensive initial training and refresher updates.



3-D Tank Target

With RETS, varying scenarios can be programmed or manually operated. Digital processing flexibility allows these programs to be easily updated to remain current with revised aggressor tactics.

When a target has been hit, a highly accurate hit sensor transmits this information to a central computer. Immediately after the training exercise, the instructor receives printouts of the trainees' scores. The instructor can then review individual scores with each soldier while the combat situation is still fresh in the trainee's mind.

Portable console.

Preliminary U.S. Army operational test results indicate the Sperry system is successful in enhancing trainee enthusiasm, in producing higher scoring accuracy, in faster trainee cycling, and in terms of equipmnent reliability.

Realistic, computer-controlled targets.

XM1 Tank Simulator

The U.S. Army's primary battle tank for the 1980s will be the 60-ton XM1. More than 7,000 of these tanks will be built for armor units based in the U.S. and overseas.

Powered by a turbine engine, the XM1 can attain highway speeds in excess of 50 m.p.h. Each tank, manned by a crew of four, carries a 105-millimeter gun and three machine guns.

The U.S. Army contracted with Sperry to design and build a driver trainer for the XM1.

The trainer consists of five trainee stations which are replicas of the tank's driver compartment. Each station contains a steering bar, throttle, brake pedal, driving and engine instruments, a maintenance monitor panel, circuit breakers, and a filter system for protection against chemical warfare—all identical to corresponding

systems and equipment in the actual XM1 driver compartment.

These five stations are electronically tied to an instructor station where automatic training computer programs are controlled.

A complex of six digital computers—one at the instructor station and one at each of the trainee stations—provides programs that simulate engine operation, driving conditions, and the operation of all systems in the XM1 with which the driver must be concerned.

Typical driving scenes are projected into a replica of the periscope which the driver uses for outside viewing when operating under combat conditions. Scenes have been recorded at actual training areas. They include highways, trails, open fields, forests, hills, obstacles—the entire range of terrain conditions over which the student must learn to drive.

When the instructor enters an automatic training program into the computer, a recorded voice gives each student instructions for performing each procedure. The instructions are contained on a tape cartridge which is controlled by the computer. This ensures synchronization with student responses.

The instructor monitors the student's actions by viewing a "training status display" on a CRT display terminal at the instructor station. Using another CRT, the instructor can observe the same visual scene the student is viewing.

Once a program is completed, the instructor receives a printed record of each student's performance, including "pass" or "fail" grades automatically calculated by the computer.

If a student needs special attention, another instructor can occupy an auxiliary station directly connected to each trainee station. This individual instructor can enter training programs into the computer and observe the student's visual scene on a CRT in the same manner as the main instructor.

Trainee stations duplicate tank driver compartment.

Sperry Corporation is one of the world's largest industrial corporations, with revenues approaching $5 billion annually. The corporation's global operations include nearly 90,000 employees, with plants, subsidiaries, and associated companies in 32 countries.

Sperry division of Sperry Corporation is a leader in guidance and control technology, in the management of sophisticated defense and commercial systems, and in marine instrumentation, navigation, and electronic systems, carrying on traditions that go back more than 70 years.

Sperry developed the first gyroscopic devices for navigation at the beginning of the century. More recently, Sperry received the first patents for the laser gyroscope, a revolutionary design which is now beginning to replace mechanical gyroscopes in a wide variety of applications.

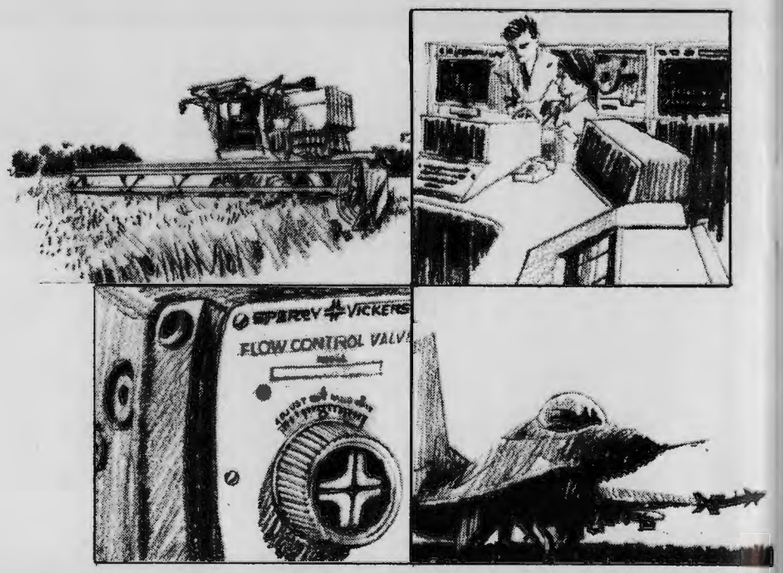
Today, Sperry is a world leader in such areas as high-precision navigation systems for submarines and surface ships, combat system and electronic systems integration, weapons control, advanced simulation and training systems, and computerized vehicular traffic control systems for highways and city streets.

A broad range of technological expertise has been employed to develop new systems for electronic signal intelligence and countermeasures, mine countermeasures, deep-sea research, underwater communications, and other defense and commercial applications. Sperry is also increasing its role as a developer of automated test systems for military electronics.

With more than 14,000 employees worldwide, including 5,000 graduate engineers, Sperry serves defense, maritime, and civilian customers on every continent. About 85 per cent of the Sperry division's $625 million in annual revenues is generated by defense projects for the United States, the United Kingdom and other allied nations.

In addition to the Sperry division, other divisions of the Sperry Corporation are:

- Sperry Univac—the originator of the commercial computer, with nearly $10 billion worth of computers installed worldwide
- Sperry New Holland—the world's largest manufacturer of specialized farm machinery
- Sperry Vickers—leading the world in the manufacture of hydraulic products, supplying everything from small components to complete fluid power systems
- Sperry Flight Systems—a major world supplier of flight instruments, navigation and control systems for commercial, defense and general aviation markets.



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